

WHAT IS CLAIMED IS:

1. A method for producing insulator structures in a semiconductor substrate, comprising:

introducing insulator trenches into the semiconductor substrate from a substrate surface of the semiconductor substrate; and

partially filling the insulator trenches with a main layer made of an additive-doped insulator material in the course of an HDP deposition process based on a high density plasma, wherein a barrier layer, which blocks an interaction of the additive with the semiconductor substrate, is produced before a deposition of the main layer in the course of the HDP deposition process.
2. The method of claim 1, wherein in the course of the HDP deposition process, before the deposition of the barrier layer, a predeposition process is controlled with exclusion of halogens or halogen compounds and an additional layer of the insulator structure is produced.
3. The method of claim 2, wherein the predeposition process of the additional layer, the production of the barrier layer and a main deposition process relating to the main layer are controlled successively and in a common process chamber.
4. The method of claim 3, wherein a halogen or a halogen compound is provided as the additive.
5. The method of claim 4, wherein fluorine or a fluorine compound is provided as the halogen.

6. The method of claim 5, wherein silicon oxide is provided as the insulator material.
7. The method of claim 6, wherein in the course of the HDP deposition process, after the production of the main layer, an auxiliary deposition process is controlled with exclusion of halogens or halogen compounds and a termination layer of the insulator structure is provided.
8. The method of claim 7, wherein material deposited above the substrate surface in the course of the HDP deposition process is caused to recede as far as the substrate surface.
9. The method of claim 8, wherein p-channel transistors are provided outside the insulator structures in the area of the substrate surface.
10. The method of claim 9, wherein silane and oxygen are supplied as chemical precursor compounds in the course of the predeposition process.
11. The method of claim 10, wherein silane, oxygen and NF₃ are supplied as chemical precursor compounds in the course of the main deposition process.
12. The method of claim 11, wherein the material of the barrier layer is selected from a group comprising Si-N, Si-O-N, Si-C, Si-O-C, amorphous silicon and nitrided silicon oxide.

13. The method of claim 11, wherein Si-N is selected as the material of the barrier layer and silane and N₂ are supplied as precursors for the production of the barrier layer.

14. The method of claim 11, wherein the insulator trenches are provided with an aspect ratio of greater than 5:1.

15. An insulator structure in a semiconductor substrate, comprising:
a main layer formed from halogen-doped silicon oxide and has emerged from an HDP deposition process; and
a barrier layer, which isolates the main layer from the semiconductor substrate and is formed in direct connection with the main layer by means of an HDP deposition process and blocks an interaction of the halogen with the semiconductor substrate.

16. The insulator structure of claim 15, further comprising:
an additional layer that isolates the barrier layer from the semiconductor substrate and is formed in direct connection with the barrier layer by means of an HDP deposition process.

17. The insulator structure of claim 16, wherein the additional layer is formed from undoped silicon oxide.

18. The insulator structure of claim 17, wherein the barrier layer comprises Si-N, Si-O-N, Si-C, Si-O-C, amorphous silicon and/or nitrided silicon oxide.

19. The insulator structure of claim 18, wherein the halogen is fluorine.
20. The insulator structure of claim 19, wherein the insulator structure is formed in an insulator trench with an aspect ratio of greater than 5:1.
21. The insulator structure of claim 20, further comprising a termination layer made of undoped silicon oxide, which is arranged on the main layer.